
ILAB I

Systems Engineering Subgroup

Data Collection Requirement Impact on Test Scenarios

Ray Yuen
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Background

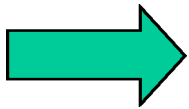
- **Objective**
 - **Identify data collection requirements resulting from process leading to operational use of four applications**
 - **Approach Spacing**
 - **Departure Spacing/Clearance**
 - **Runway and Final Approach Occupancy Awareness**
 - **Airport Surface Situational Awareness**
- **Approach**
 - **Leverage SF 21 planning and management activities to identify issues**
 - **Master Plan**
 - **Level II Planning (aka “Application Scorecard”)**
 - **RTCA 13 steps**
 - **Derive data collection requirements from issues**
 - **SF 21 Cost/Benefits, Tech/Cert Subgroup**
 - **Requirements Evaluation Plan**
 - **Preliminary Hazard Assessment**
 - **Issues & Resolution Process for Certification and Operational Approval**

Scope

- **Op Eval II applications**
- **Data collection modes**
 - **Discussions**
 - **Research and analysis**
 - **Simulations**
 - **Integration testing**
 - **In-service testing**
 - **Op Eval flight testing**
- **Data collection instruments**
 - **Data collectors/observers**
 - **Surveys**
 - **Interviews**
 - **Radar data**
 - **ADS-B track data**

13 Steps

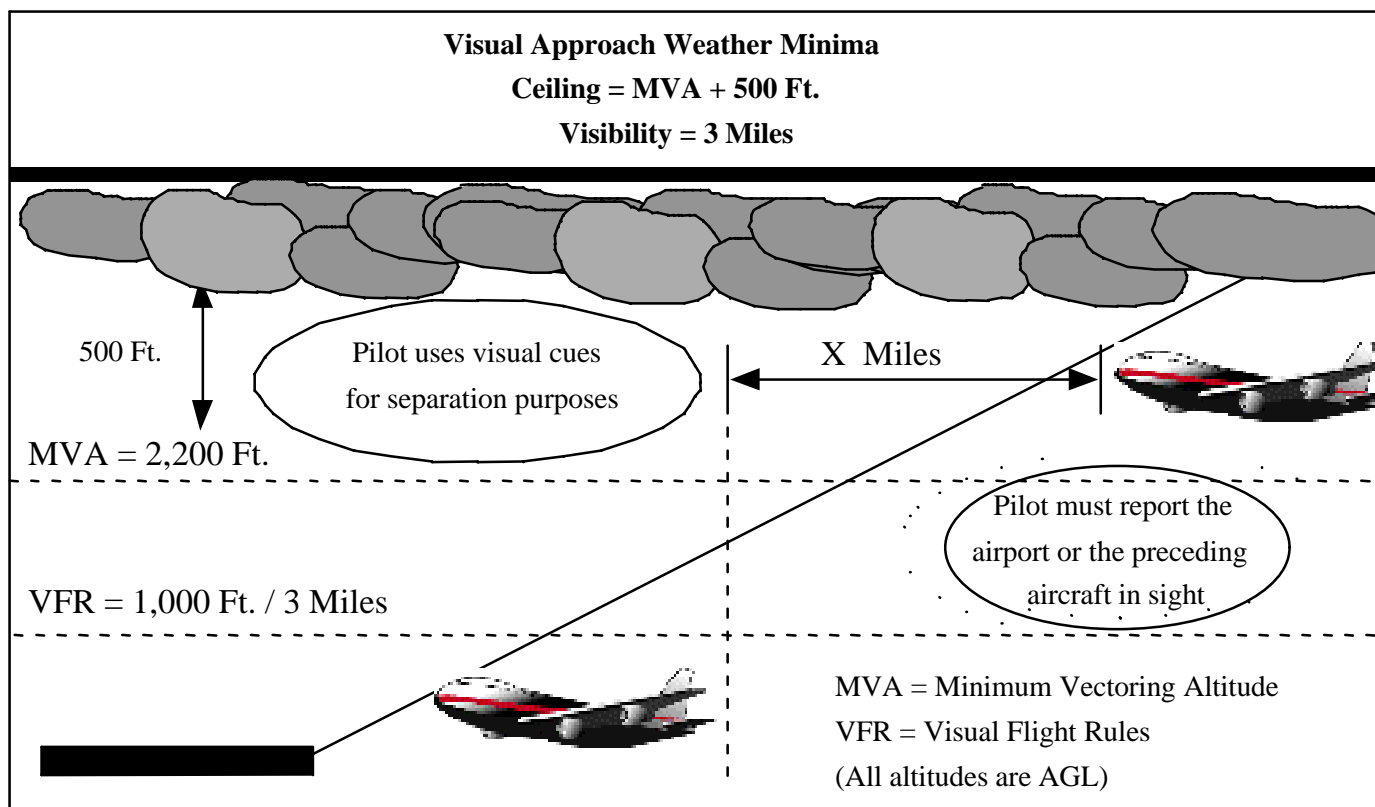
- Operational Concept
 - **Benefits and Constraints**
 - Maturity of Concept and Technology
 - **Operational Procedures**
 - **Human Factors**
 - **End-to-End Performance and Technical Requirements**
 - **Interoperability Requirements for Air and Ground Systems**
 - **Operational Safety Assessment**
 - Equipment, Development, Test and Evaluation
 - **Operational Test and Evaluation**
-
- **Equipment Certification (Air and Ground)**
 - **Operational Approval**
 - Implementation Transition



Test Scenario Requirements

- **Divided by application**
- **Issue collection is on-going**
- **Significant overlap in requirements from 13 steps**

Approach Spacing (for Visual Approach)



Approach Spacing Requirements: Benefits and Constraints

- **Safety**
 - **Baseline developed through in-service testing/historical sources**
 - **Survey applied during Opeval to estimate improvement indirectly**
- **User Cost Savings**
 - **Baseline testing during Opeval for**
 - **Flying time during final approach maneuvers**
 - **Flight time from final approach fix to touchdown**
 - **Opeval data for times and distances**
 - **Survey applied during Opeval to ascertain pilot confidence**
- **FAA Cost Savings**
 - **Baseline testing during Opeval for**
 - **# mis-identifications by pilots**
 - **# repeated traffic call-outs by ATC**
 - **Opeval data for times and distances**
- **Items for Discussion**
 - **Advanced tools vs limited tools**
 - **Minimum amount of baseline testing?**
 - **Controlled for meteorological conditions, flight crew/ATC experience**

Approach Spacing Requirements: Operational Procedures and Human Factors

- **Requirements Drivers**
 - **Mixed Equipage**
 - **What ADS-B aircraft data displayed to controllers/pilots**
 - **How should ADS-B data be presented to controllers/pilots**
 - **Effect of changes in roles on controllers and pilots**
 - **Procedure changes necessary regarding display interpretation and evolving roles**
- **Surveys, interviews, observers employed during Opeval to support procedure and display development**
- **Items for Discussion**
 - **Definition of mixed equipage**
 - **Number of variations to be examined/impact on benefits data**

Approach Spacing Requirements: End-to-End Performance and Interoperability

- **Requirements Drivers**
 - **Multipath performance of all three candidate links on low elevation angle air-to-ground links**
 - **Interference levels for UAT and VDL Mode 4**
 - **Fusion of ADS-B and other surveillance data**
- **Controlled technical testing conducted by FAATC A/C, SF 21 Van conducted in conjunction with integration testing or other non-Opeval flight testing**
- **Items for Discussion**
 - **VDL Mode 4 equipage**

Approach Spacing Requirements: Operational Safety Assessment

- **Requirements Drivers**
 - **Loss or corruption of specific data elements within message, entire messages or full loss of capability (detected or undetected)**
 - **Crew or ATC error in employing ADS-B data (esp mixed equipage)**
 - **Incorrect CDTI operation due to mode selection, clutter**
 - **Reduced spacing (trailing aircraft)**
 - **Controller/flight crew workload**
 - **Message spoofing**
- **Surveys, interviews, observers employed during Opeval to identify incorrect operation or severe workload situations. Correlate survey, interview, observer data with received ADS-B data.**
- **Items for Discussion**
 - **No specific Opeval events to exercise failure modes**
 - **Failure modes exercised in flight simulator**

Approach Spacing Requirements: Equipment Certification

- **Requirements Drivers**
 - Clarification of Intended Function.
 - Essential vs. Non-essential.
 - Verification of positional accuracy; both ownship & of ADS-B targets.
 - Hazard Assessment.
 - Human Factors; CDTI location, presentation and accuracy of information.
 - AFM limitations for VMC only use.
- **Surveys, interviews, observers employed during Opeval to assess CDTI mounting, work load and clutter reduction (flight crews and controllers). Opeval ADS-B flight test data compared to location ground truth system.**
- **Items for Discussion**
 - **Availability of location ground truth system**
 - **One/two/three crew aircraft in scenario**

Approach Spacing Requirements: Equipment Certification

- Which, if any, OE2 applications require the CDTI to be in the pilot's primary field of view?
- Is the CDTI for the OpEval II applications essential or non essential? A policy determination needs to be made.
- What is the ultimate intended function of the equipment proposed in the current Certification Plan? The equipment being proposed in the current Certification Plan is an aircraft conflict situational awareness function, operationally and functionally equivalent to TCAS TAs. The OE-2 plans take the ADS-B intended function well beyond "aid to visual acquisition with alerting" (SF 21 applications 3.1.1 and 4.2.1).
- What will be the failure classification and software level required for the equipment that supports each of the OpEval II applications? (Need an OSA / FHA).
- **How accurate is ADS-B position data and how well does it correlate with reality? Big cert question if system is to be more than an aid to visual acquisition, such as to support approach spacing. Own ship and target aircraft need to be included. Need to measure the lateral and vertical accuracy of the ADS-B position reports, versus real world. (How accurate are NUC values?)**
- **Given the current location of the CDTI on a B727, does the speed brake handle impair the flight crew's view and use of the display for each OpEval II application?**
- **Is the display distance from the pilot's eyes in the 727 acceptable for the pilot population's age perspective?**

Approach Spacing Requirements: Equipment Certification

- **Need an assessment of flight crew workload to do the four applications in OpEval II. Can pilots do the new work, and fly the airplane?**
- **For each application in the current Certification Plan and OpEval II, assess crew workload in a one / two / three-person crew. Determine if the scope of work overburdens the crew members.**
- **Research clutter issue on the airport surface. How will that be addressed in OpEval II?**
- **Clutter issue for controllers at LOU -- ground and air. Will the OpEval II common arts software be able to filter aircraft by ground / air, and if air, by altitude?**
- **There needs to be a means to address intentional spoofing. That means needs to be evaluated as a deterrent in OpEval II. Evaluation can include discussions, analyses, part-task simulation or flight evaluation.**
- **There needs to be a way to reduce display clutter for the controller and pilot. One way that it may be implemented is by selectively filtering based on altitude bands and range, e.g., sampling a “hockey puck” of airspace at a time. Another example of a clutter reduction strategy is the use of 2D and 3D depictions of aircraft silouettes on a CDTI, especially if the data tags can be selectively disabled.**
- **There needs to be a clearly defined process to allow the initial ADS-B applications to be certified to migrate from VMC use only to fully IMC approved.**

Approach Spacing Requirements: Operational Approval

- **Requirements Drivers**
 - See issues
- **Surveys, interviews, observers employed during Opeval to assess pilot procedures, competency with basic functionality, etc.**
- **Items for Discussion**
 - Mixed aircraft
 - Transition from en route to surface situational awareness

Approach Spacing Requirements: Operational Approval

- Should GA safety seminars with information on the OpEval II flight evaluations and on enhanced pilot decision making be scheduled for October? How many and when?
- **Need a pilot's ops procedure for each application. What duties will the pilot be expected to do, and when?**
- **Need checklists for each application.**
- What type of equipment is needed for training for each application that appears in the current Certification Plan and those that will be demonstrated in OpEval II?
- **How will one evaluate pilot competency in the testing of each pilot's ability to perform each application?**
- How will initial operational approvals for various air carriers be harmonized so that the training and procedures are common and “seamless”, e.g. UPS w/ UPS, UPS w/ FedEx, etc.
- How will training for OpEval be harmonized?

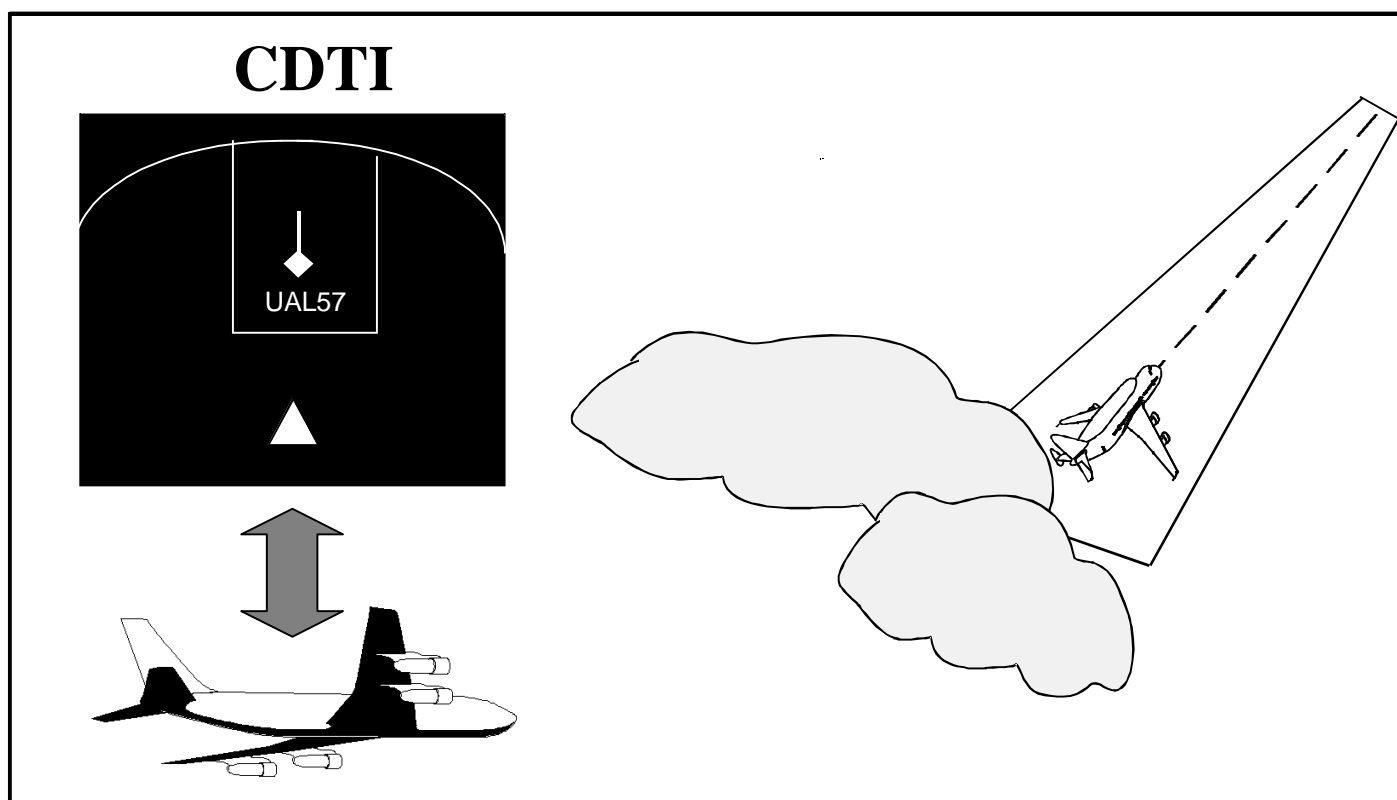
Approach Spacing Requirements: Operational Approval

- **Will there be any difference in intended (i.e., end-state) functionality for the equipment as installed on each aircraft, by fleet type? How might these different equipage installations affect crew performance during normal flight operations?**
- **How is ADS-B capability (and degraded capability in case of degraded system) conveyed to ATC? What are the requirements to advise ATC of a degraded system such as is now required for a degraded nav systems.**
- **Define the in-service evaluation requirements for post ops approval/OpEval II.**
- **Define spectrum needed, and whether it will be air only or air / ground use. If there is a unique spectrum requirement that impacts flight procedures, that requirement needs to be passed to the FSDO.**
- **Evaluate aircraft with various Vref speeds (i.e., classes) for approach spacing application to assess real-world mixed aircraft arrivals.**
- **There needs to be work done to evaluate how a pilot will transition from an en route display depiction to an airport map depiction, and still maintain situational awareness.**

Approach Spacing Requirements: Summary

- **Controlled Technical Testing**
 - **Multipath**
 - **Co-channel interference**
- **Baseline**
 - **In-service testing/historical data**
 - **Opeval**
- **Opeval**
 - **Tools**
 - **Procedures**
 - **Location validation**
 - **Mixed equipage**
 - **Mixed aircraft (V_{ref} and crew complement)**

Runway and Final Approach Occupancy Awareness



Runway and Final Approach Requirements: Benefits and Constraints

Safety

-
- Survey applied during to estimate improvement indirectly
-
- Opeval
- Survey applied during to ascertain pilot confidence/awareness
-
- Baseline testing during for closest separation distance
- data for times and distances
-
- Minimum amount of baseline testing?
Controlled for meteorological conditions, flight crew/ATC experience

Runway and Final Approach Requirements: Operational Procedures and Human Factors

- **Requirements Drivers**
 - **Mixed Equipage**
 - **What ADS-B aircraft data should be displayed to controllers/pilots**
 - **How should ADS-B data be presented to controllers/pilots**
 - **Effect of changes in roles on controllers and pilots**
 - **Procedure changes necessary regarding display interpretation and evolving roles**
- **Surveys, interviews, observers employed during Opeval to support procedure and display development**
- **Items for Discussion**
 - **Definition of mixed equipage**
 - **Number of variations to be examined/impact on benefits data**

Runway and Final Approach Requirements: End-to-End Performance and Interoperability

- **Requirements Drivers**
 - **Multipath
ground links**
 - **Interference levels for UAT and VDL Mode 4**
 - **Fusion of ADS-B and other surveillance data**
- **Controlled technical testing conducted by FAATC A/C, SF 21 Van
Opeval
flight testing**
- **Items for Discussion**
 - **VDL Mode 4 equipage**

Runway and Final Approach Requirements: Operational Safety Assessment

- **Requirements Drivers**
 - **Loss or corruption of specific data elements within message, entire messages or full loss of capability (detected or undetected)**
 - **Crew or ATC error in employing ADS-B data (esp mixed equipage)**
 - **Incorrect CDTI operation due to mode selection, clutter**
 - **Controller/flight crew workload**
 - **Message spoofing**
- **Surveys, interviews, observers employed during Opeval to identify incorrect operation or severe workload situations. Correlate survey, interview, observer data with received ADS-B data.**
- **Items for Discussion**
 - **No specific Opeval events to exercise failure modes**
 - **Failure modes exercised in flight simulator**

Runway and Final Approach Requirements: Equipment Certification

- **Requirements Drivers**

- Clarification of Intended Function.
- Essential vs
Verification of positional accuracy; both ownship & of ADS-B targets.
- Human Factors; CDTI location, presentation and accuracy of information.
-

Surveys, interviews, observers employed during Opeval to assess CDTI mounting, work load and clutter reduction (flight crews and controllers). Opeval ADS-B flight test data and map data bases compared to location ground truth system.

-

Availability of location ground truth system

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Runway and Final Approach Requirements:

Which, if any, OE2 applications require the CDTI to be in the pilot's primary field of view?

- Opeval II applications essential or non essential? A policy determination needs to be

What is the ultimate intended function of the equipment proposed in the current equipment being proposed in the current Certification Plan is an aircraft conflict situational awareness TAs. The OE-2 plans take the ADS-B

4.2.1).

- What will be the failure classification and software level required for the equipment that supports each of OpEval II applications? (Need an OSA / FHA).
- **How accurate is ADS-B position data and how well does it correlate with reality? Big cert approach spacing. Own ship and target aircraft need to be included. Need to measure the lateral and vertical accuracy of the ADS-B position reports, versus real world. (How**

Given the current location of the CDTI on a B727, does the speed brake handle impair the flight crew's view and use of the display for each OpEval II application?

- **population's age perspective?**

Runway and Final Approach Requirements: Equipment Certification

- **Need an assessment of flight crew workload to do the four applications in OpEval II. Can pilots do the new work, and fly the airplane?**
- **For each application in the current Certification Plan and OpEval II, assess crew workload in a one / two / three-person crew. Determine if the scope of work overburdens the crew members.**
- **Research clutter issue on the airport surface. How will that be addressed in OpEval II?**
- **Clutter issue for controllers at LOU -- ground and air. Will the OpEval II common arts software be able to filter aircraft by ground / air, and if air, by altitude?**
- **There needs to be a means to address intentional spoofing. That means needs to be evaluated as a deterrent in OpEval II. Evaluation can include discussions, analyses, part-task simulation or flight evaluation.**
- **There needs to be a way to reduce display clutter for the controller and pilot. One way that it may be implemented is by selectively filtering based on altitude bands and range, e.g., sampling a “hockey puck” of airspace at a time. Another example of a clutter reduction strategy is the use of 2D and 3D depictions of aircraft silouettes on a CDTI, especially if the data tags can be selectively disabled.**

Runway and Final Approach Requirements: Equipment Certification

- **Validate the attributes associated with an airport map database, including validation of the accuracy, resolution, and integrity of the data base. There is a need to compare the characteristics of independently designed and developed databases (i.e., NOAA and Jep, others?); need to evaluate design and actual functionality.**
- **An evaluation of the airport map data base in a CDTI and moving map mode application. What are the critical data that supports safety and must be reported with a high degree of accuracy and other attributes, and what other functionality and data are situational and may be reported at lesser degrees of accuracy.**
- **Evaluate critical (defined by issue above) airport map feature “completeness” at SDF and MEM. Taxi around airport and ensure critical safety-related features have been captured.**
- **There needs to be a clearly defined process to allow the initial ADS-B applications to be certified to migrate from VMC use only to fully IMC approved.**

Operational Approval

- **Requirements Drivers**
 - See issues
- **Surveys, interviews, observers employed during to assess pilot procedures, display options, competency with basic functionality, etc.**
- **Items for Discussion**
 - Mixed aircraft
 - Transition from en route to surface situational awareness

Runway and Final Approach Requirements: Operational Approval

- Should GA safety seminars with information on the OpEval II flight evaluations and on enhanced pilot decision making be scheduled for October? How many and when?
- **Need a pilot's ops procedure for each application. What duties will the pilot be expected to do, and when?**
- **Need checklists for each application.**
- What type of equipment is needed for training for each application that appears in the current Certification Plan and those that will be demonstrated in OpEval II?
- **How will one evaluate pilot competency in the testing of each pilot's ability to perform each application?**
- How will initial operational approvals for various air carriers be harmonized so that the training and procedures are common and "seamless", e.g. UPS w/ UPS, UPS w/ FedEx, etc.
- How will training for OpEval be harmonized?

Runway and Final Approach Requirements: Operational Approval

- **Will there be any difference in intended (i.e., end-state) functionality for the equipment as installed on each aircraft, by fleet type? How might these different equipage installations affect crew performance during normal flight operations?**
- **How is ADS-B capability (and degraded capability in case of degraded system) conveyed to ATC? What are the requirements to advise ATC of a degraded system such as is now required for a degraded nav systems.**
- Define the in-service evaluation requirements for post ops approval/OpEval II.
- Define spectrum needed, and whether it will be air only or air / ground use. If there is a unique spectrum requirement that impacts flight procedures, that requirement needs to be passed to the FSDO.

Operational Approval

- **Investigate the merits of additional alerting cues for runway surface movement precise position of aircraft on the airport surface including whether part of the aircraft (such as the aircraft's tail) overhangs the RSA, along with the merits of model, aircraft heading at Vstop etc.**
- **Investigate the work / status of NASA's synthetic vision work to ensure that II is aware of this work, and can benefit from it. This includes the work being done in Germany.**

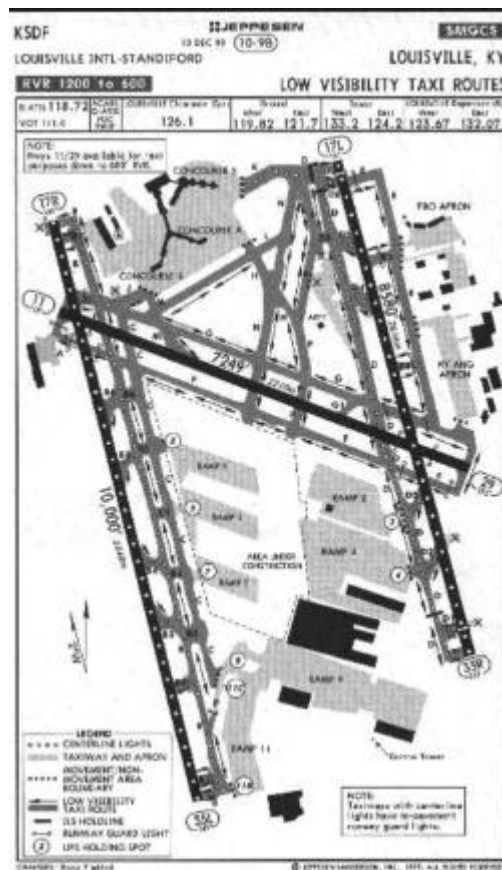
Investigate the work of the Swedes and Carmetta in the surface map and surface movement applications to ensure that this knowledge base is accessed by OpEval II. Do not duplicate work already done.
- **Vref speeds (i.e., classes) for approach spacing**

There needs to be work done to evaluate how a pilot will transition from an en route display depiction to an airport map depiction, and still maintain situational awareness.

Runway and Final Approach Requirements: Summary

- **Controlled Technical Testing**
 - **Multipath**
 - **Co-channel interference**
 - **Map data base validation**
- **Baseline**
 - **In-service testing/historical data**
 - **Opeval**
- **Opeval**
 - **Procedures**
 - **Location validation**
 - **Mixed equipage**
 - **Mixed aircraft (V_{ref} and crew complement)**

Airport Surface Situation Awareness



Benefits and Constraints

- **Safety**
 - **Baseline developed through in-service testing/historical sources**
 - **Survey applied during to estimate improvement indirectly**
- **User Cost Savings**
 - **Opeval data for pilot awareness**
 - **Survey applied during Opeval**

FAA Cost Savings

- **Opeval for closest separation distance**
 - **Opeval data for times and distances**
- **Items for Discussion**
 - **Minimum amount of baseline testing?**
 - **Controlled for meteorological conditions, flight crew/ATC experience**

Surface Situation Awareness Requirements: Operational Procedures and Human Factors

- **Requirements Drivers**
 - **Mixed Equipage**
 - **What ADS-B aircraft data should be displayed to controllers/pilots**
 - **How should ADS-B data be presented to controllers/pilots**
 - **Effect of changes in roles on controllers and pilots**
 - **Procedure changes necessary regarding display interpretation and evolving roles**
- **Surveys, interviews, observers employed during Opeval to support procedure and display development**
- **Items for Discussion**
 - **Definition of mixed equipage**
 - **Number of variations to be examined/impact on benefits data**

Surface Situation Awareness Requirements: End-to-End Performance and Interoperability

- **Requirements Drivers**
 - **Multipath performance of all three candidate links on ground-to-ground links**
 - **Interference levels for UAT and VDL Mode 4**
 - **Fusion of ADS-B and other surveillance data**
- **Controlled technical testing conducted by FAATC A/C, SF 21 Van conducted in conjunction with integration testing or other non-Opeval flight testing**
- **Items for Discussion**
 - **VDL Mode 4 equipage**

Operational Safety Assessment

- **Requirements Drivers**
 - **Loss or corruption of specific data elements within message, entire messages or full loss of capability (detected or undetected)**
 - **Crew or ATC error in employing ADS-B data (esp
Incorrect CDTI operation due to mode selection, clutter**
 - **Message spoofing**
- **Opeval to identify
interview, observer data with received ADS-B data.**
- **Items for Discussion**
 - **No specific Opeval**

Surface Situation Awareness Requirements: Equipment Certification

- **Requirements Drivers**
 - Clarification of Intended Function.
 - Essential vs. Non-essential.
 - Verification of positional accuracy; both ownship & of ADS-B targets.
 - Hazard Assessment.
 - Human Factors; CDTI location, presentation and accuracy of information.
 - AFM limitations for VMC only use.
- **Surveys, interviews, observers employed during Opeval to assess CDTI mounting, work load and clutter reduction (flight crews and controllers). Opeval ADS-B flight test data and map data bases compared to location ground truth system.**
- **Items for Discussion**
 - Availability of location ground truth system
 - One/two/three crew aircraft in scenario

Surface Situation Awareness Requirements: Equipment Certification

- Which, if any, OE2 applications require the CDTI to be in the pilot's primary field of view?
- Is the CDTI for the Opeval II applications essential or non essential? A policy determination needs to be made.
- What is the ultimate intended function of the equipment proposed in the current Certification Plan? The equipment being proposed in the current Certification Plan is an aircraft conflict situational awareness function, operationally and functionally equivalent to TCAS TAs. The OE-2 plans take the ADS-B intended function well beyond "aid to visual acquisition with alerting" (SF 21 applications 3.1.1 and 4.2.1).
- What will be the failure classification and software level required for the equipment that supports each of the OpEval II applications? (Need an OSA / FHA).
- **How accurate is ADS-B position data and how well does it correlate with reality? Big cert question if system is to be more than an aid to visual acquisition, such as to support approach spacing. Own ship and target aircraft need to be included. Need to measure the lateral and vertical accuracy of the ADS-B position reports, versus real world. (How accurate are NUC values?)**
- **Given the current location of the CDTI on a B727, does the speed brake handle impair the flight crew's view and use of the display for each OpEval II application?**
- **Is the display distance from the pilot's eyes in the 727 acceptable for the pilot population's age perspective?**

Surface Situation Awareness Requirements: Equipment Certification

- **OpEval II.**

For each application in the current Certification Plan and OpEval II, assess crew workload in a one / two / three-person crew. Determine if the scope of work overburdens the crew members.

- **OpEval II?**
- **Clutter issue for controllers at LOU -- ground and air. Will the OpEval arts software be able to filter aircraft by ground / air, and if air, by altitude?**
- **There needs to be a means to address intentional spoofing. That means needs to be evaluated as a OpEval II. Evaluation can include discussions, analyses, part-task simulation or flight**

There needs to be a way to reduce display clutter for the controller and pilot. One way that it may be implemented is by selectively filtering based on altitude bands and range, e.g., sampling a “hockey puck” of airspace at a time. Another example of a clutter reduction strategy is the use of 2D and 3D depictions of aircraft silouttettes on a CDTI, especially if the data tags can be selectively disabled.

Surface Situation Awareness Requirements: Equipment Certification

- **Validate the attributes associated with an airport map database, including validation of the accuracy, resolution, and integrity of the data base. There is a need to compare the characteristics of independently designed and developed databases (i.e., NOAA and Jep, others?); need to evaluate design and actual functionality.**
- **An evaluation of the airport map data base in a CDTI and moving map mode application. What are the critical data that supports safety and must be reported with a high degree of accuracy and other attributes, and what other functionality and data are situational and may be reported at lesser degrees of accuracy.**
- **Evaluate critical (defined by issue above) airport map feature “completeness” at SDF and MEM. Taxi around airport and ensure critical safety-related features have been captured.**
- **There needs to be a clearly defined process to allow the initial ADS-B applications to be certified to migrate from VMC use only to fully IMC approved.**

Surface Situation Awareness Requirements: Operational Approval

- **Requirements Drivers**
 - See issues
- **Surveys, interviews, observers employed during Opeval procedures, display options, competency with basic functionality, etc.**
- **Items for Discussion**
 - Mixed aircraft
 - Transition from en route to surface situational awareness

Surface Situation Awareness Requirements: Operational Approval

- Should GA safety seminars with information on the OpEval II flight evaluations and on enhanced pilot decision making be scheduled for October? How many and when?
- **Need a pilot's ops procedure for each application. What duties will the pilot be expected to do, and when?**
- **Need checklists for each application.**
- What type of equipment is needed for training for each application that appears in the current Certification Plan and those that will be demonstrated in OpEval II?
- **How will one evaluate pilot competency in the testing of each pilot's ability to perform each application?**
- How will initial operational approvals for various air carriers be harmonized so that the training and procedures are common and "seamless", e.g. UPS w/ UPS, UPS w/ FedEx, etc.
- How will training for OpEval be harmonized?

Surface Situation Awareness Requirements: Operational Approval

- **Will there be any difference in intended (i.e., end-state) functionality for the equipment as installed on each aircraft, by fleet type? How might these operations?**
- **How is ADS-B capability (and degraded capability in case of degraded system) system such as is now required for a degraded nav**

Define the in-service evaluation requirements for post ops approval/OpEval II.

- spectrum requirement that impacts flight procedures, that requirement needs to be passed to the FSDO.

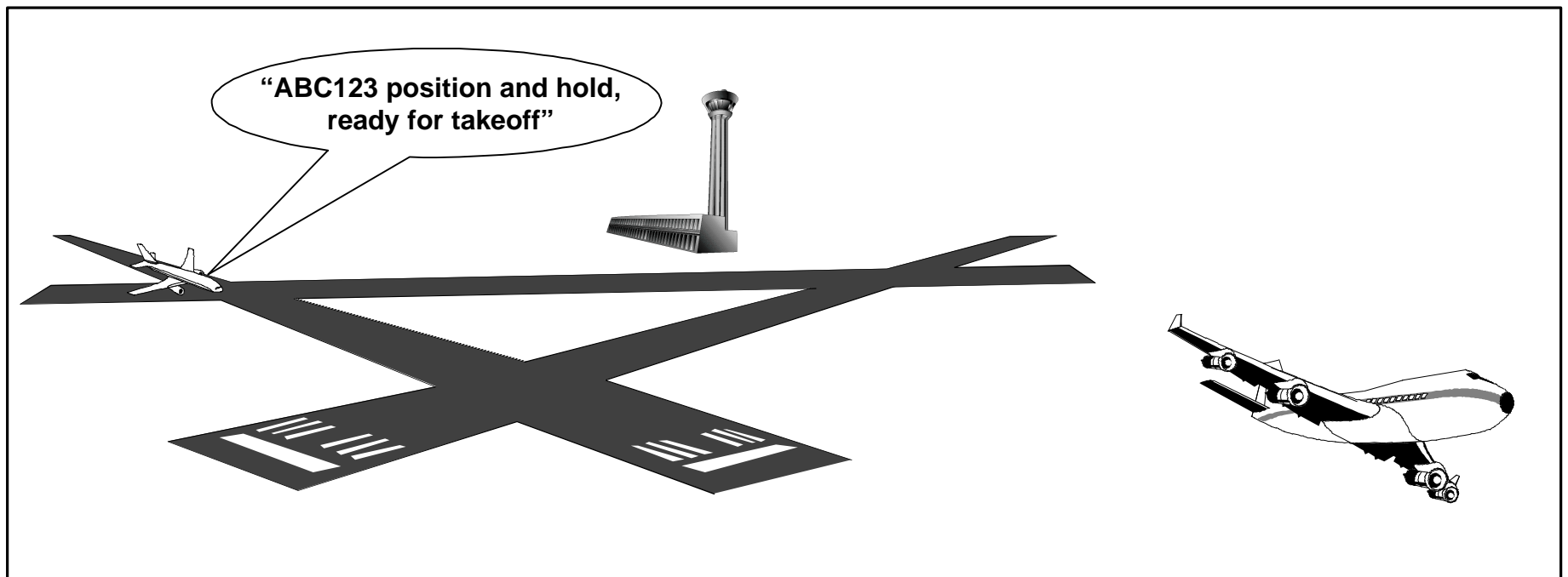
Surface Situation Awareness Requirements: Operational Approval

- **Investigate the merits of additional alerting cues for runway surface movement applications. Cues discussed include aircraft silhouette depictions to show the precise position of aircraft on the airport surface including whether part of the aircraft (such as the aircraft's tail) overhangs the RSA, along with the merits of transmitting additional ADS-B message set information such as aircraft make / model, aircraft heading at Vstop, brakes "on" / "off", engine percentage power, etc.**
- Investigate the work / status of NASA's synthetic vision work to ensure that OpEval II is aware of this work, and can benefit from it. This includes the work being done in Germany. Do not duplicate work already done.
- Investigate the work of the Swedes and Carmetta in the surface map and surface movement applications to ensure that this knowledge base is accessed by OpEval II. Do not duplicate work already done.
- **There needs to be work done to evaluate how a pilot will transition from an en route display depiction to an airport map depiction, and still maintain situational awareness.**

Surface Situation Awareness Requirements: Summary

- **Controlled Technical Testing**
 - **Multipath**
 - **Co-channel interference**
 - **Map data base validation**
- **Baseline**
 - **In-service testing/historical data**
 - **Opeval**
- **Opeval**
 - **Procedures**
 - **Location validation**
 - **Mixed equipage**
 - **Mixed aircraft (crew complement)**

Departure Spacing



Departure Spacing Requirements: Benefits and Constraints

- **Safety**
 - **Baseline developed through in-service testing/historical sources**
 - **Survey applied during Opeval to estimate improvement indirectly**
- **User Cost Savings**
 - **Baseline testing during Opeval for**
 - **Time taken by pilot to visually acquire lead aircraft**
 - **Time taken by pilot to verify lead flight**
 - **Time taken by pilot to match the speed profile of leading flight**
- **Opeval data for times and distances**
 - **Survey applied during Opeval to ascertain pilot confidence**
- **FAA Cost Savings**
 - **Baseline testing during Opeval for**
 - **# and duration of ATC comms**
 - **Opeval data for times and distances**
- **Items for Discussion**
 - **Advanced tools vs limited tools**
 - **Minimum amount of baseline testing?**
 - **Controlled for meteorological conditions, flight crew/ATC experience**

Departure Spacing Requirements:

Requirements Drivers

- What ADS-B aircraft data displayed to controllers/pilots
- Effect of changes in roles on controllers and pilots
- evolving roles
- Surveys, interviews, observers employed during procedure and display development to support
- Items for Discussion
 - Definition of mixed equipage
 - Number of variations to be examined/impact on benefits data

Departure Spacing Requirements: End-to-End Performance and Interoperability

- **Requirements Drivers**
 - **Multipath performance of all three candidate links on low elevation angle air-to-ground links**
 - **Interference levels for UAT and VDL Mode 4**
 - **Fusion of ADS-B and other surveillance data**
- **Controlled technical testing conducted by FAATC A/C, SF 21 Van conducted in conjunction with integration testing or other non-Opeval flight testing**
- **Items for Discussion**
 - **VDL Mode 4 equipage**

Departure Spacing Requirements: Operational Safety Assessment

- **Requirements Drivers**
 - **Loss or corruption of specific data elements within message, entire messages or full loss of capability (detected or undetected)**
 - **Crew or ATC error in employing ADS-B data (esp mixed equipage)**
 - **Incorrect CDTI operation due to mode selection, clutter**
 - **Controller/flight crew workload**
 - **Message spoofing**
- **Surveys, interviews, observers employed during Opeval to identify incorrect operation or severe workload situations. Correlate survey, interview, observer data with received ADS-B data.**
- **Items for Discussion**
 - **No specific Opeval events to exercise failure modes**
 - **Failure modes exercised in flight simulator**

Equipment Certification

- **Requirements Drivers**
 - Clarification of Intended Function.
 - Essential . Non-essential.
 - Verification of positional accuracy; both & of ADS-B targets.
 - Hazard Assessment.
 - Human Factors; CDTI location, presentation and accuracy of information.
 - AFM limitations for VMC only use.
- **Surveys, interviews, observers employed during to assess CDTI mounting, work load and clutter reduction (flight crews and Opeval ADS-B flight test data compared to location**

Items for Discussion

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One/two/three crew aircraft in scenario

Departure Spacing Requirements: Equipment Certification

- Which, if any, OE2 applications require the CDTI to be in the pilot's primary field of view?
- Is the CDTI for the Opeval II applications essential or non essential? A policy determination needs to be made.
- What is the ultimate intended function of the equipment proposed in the current Certification Plan? The equipment being proposed in the current Certification Plan is an aircraft conflict situational awareness function, operationally and functionally equivalent to TCAS TAs. The OE-2 plans take the ADS-B intended function well beyond "aid to visual acquisition with alerting" (SF 21 applications 3.1.1 and 4.2.1).
- What will be the failure classification and software level required for the equipment that supports each of the OpEval II applications? (Need an OSA / FHA).
- **How accurate is ADS-B position data and how well does it correlate with reality? Big cert question if system is to be more than an aid to visual acquisition, such as to support approach spacing. Own ship and target aircraft need to be included. Need to measure the lateral and vertical accuracy of the ADS-B position reports, versus real world. (How accurate are NUC values?)**
- **Given the current location of the CDTI on a B727, does the speed brake handle impair the flight crew's view and use of the display for each OpEval II application?**
- **Is the display distance from the pilot's eyes in the 727 acceptable for the pilot population's age perspective?**

Departure Spacing Requirements:

**Need an assessment of flight crew workload to do the four applications in OpEval II.
Can pilots do the new work, and fly the airplane?**

- **OpEval II, assess crew**

overburdens the crew members.
- **Research clutter issue on the airport surface. How will that be addressed in II?**
- **Clutter issue for controllers at LOU -- ground and air. Will the II common arts software be able to filter aircraft by ground / air, and if air, by altitude?**
- **There needs to be a means to address intentional spoofing. That means needs to be evaluated as a deterrent in II. Evaluation can include discussions, analyses, part-task simulation or flight evaluation.**
- **There needs to be a way to reduce display clutter for the controller and pilot. One way that it may be implemented is by selectively filtering based on altitude bands and range,**

reduction strategy is the use of 2D and 3D depictions of aircraft silouettes especially if the data tags can be selectively disabled.
- **There needs to be a clearly defined process to allow the initial ADS-B applications to be certified to**

Departure Spacing Requirements: Operational Approval

- **Requirements Drivers**
 - See issues
- **Surveys, interviews, observers employed during Opeval to assess pilot procedures, competency with basic functionality, etc.**
- **Items for Discussion**
 - Mixed aircraft
 - Transition from en route to surface situational awareness

Departure Spacing Requirements:

Should GA safety seminars with information on the OpEval II flight evaluations and on enhanced pilot decision making be scheduled for October? How many and when?

- **expected to do, and when?**
- **Need checklists for each application.**
- What type of equipment is needed for training for each application that appears in the current Certification Plan and those that will be demonstrated in II?
- **How will one evaluate pilot competency in the testing of each pilot's ability to**

How will initial operational approvals for various air carriers be harmonized so that the training and procedures are common and “seamless”, e.g. UPS w/ UPS, UPS w/ FedEx, etc.

- OpEval be harmonized?

Departure Spacing Requirements: Operational Approval

- **Will there be any difference in intended (i.e., end-state) functionality for the equipment as installed on each aircraft, by fleet type? How might these different equipage installations affect crew performance during normal flight operations?**
- **How is ADS-B capability (and degraded capability in case of degraded system) conveyed to ATC? What are the requirements to advise ATC of a degraded system such as is now required for a degraded nav systems.**
- **Define the in-service evaluation requirements for post ops approval/OpEval II.**
- **Define spectrum needed, and whether it will be air only or air / ground use. If there is a unique spectrum requirement that impacts flight procedures, that requirement needs to be passed to the FSDO.**
- **Evaluate aircraft with various Vref speeds (i.e., classes) for approach spacing application to assess real-world mixed aircraft arrivals.**
- **There needs to be work done to evaluate how a pilot will transition from an en route display depiction to an airport map depiction, and still maintain situational awareness.**

Departure Spacing Requirements: Summary

- **Controlled Technical Testing**
 - **Multipath**
 - **Co-channel interference**
- **Baseline**
 - **In-service testing/historical data**
 - **Opeval**
- **Opeval**
 - **Tools**
 - **Procedures**
 - **Location validation**
 - **Mixed equipage**
 - **Mixed aircraft (crew complement)**

Scenario Summary

- **Controlled Technical Testing**
 - **Multipath**
 - **Co-channel interference**
 - **Map data base validation**
- **Baseline**
 - **In-service testing/historical data**
 - **Opeval**
- **Opeval**
 - **Tools**
 - **Procedures**
 - **Location validation**
 - **Mixed equipage**
 - **Mixed aircraft (Vref and crew complement)**